Interim Progress Report submitted to NOAA's Human Dimensions of Global Change Research (HDGCR) Program: Project Title:

"Support of a Climate-Informed Water Bank"

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I. Preliminary Materials.
A. Project Abstract (Text Limit: one page)

This project continues to build on 3 years of work in the Arkansas Valley of Colorado that has identified the actual and potential uses of climate information by water managers at all levels (see final report of 05/20/04). The major objective of the current project has been to describe and evaluate the evolution of new institutions that have been created to deal with drought-related issues in the Arkansas Valley. The 2001-2002 drought was expected to increase appreciation of the importance of flexibility in water allocation among users in response to climate variability. Indeed, there have been major institutional innovations in the past 2 years, including the establishment of the Arkansas River Water Bank Pilot Program (WBPP) (operational January 2003), the establishment of the Lower Arkansas Valley Water Conservancy District, and the Agricultural Land Trust, all of which are intended to increase the efficiency of water use in agriculture and to keep water rights in the Valley. The earlier "Three States Project" successfully participated in the design of the Water Bank and associated regulations, as well as assisting in studies supporting the new Lower Arkansas Water Conservancy District. The current project continues to promote the Water Bank through public educational activities and research relating to the more effective use of climate information by the ditch companies and towns that comprise the potential water bank participants.

A major finding to date is that the Water Bank has not been accepted by potential buyers and sellers, resulting in no transactions. Extensive interviewing in the Valley has identified several reasons for this institutional failure: (a) the absence of a "price discovery" mechanism by which potential buyers & sellers could set reasonable prices for water; (b) lack of familiarity with the computerized bank procedures by the older farmers who own most of the water; (c) lack of adequate outreach education prior to opening the bank to assure existing water users that they would not be injured by the Water Bank's activities; (d) the possibility that many beneficial trade opportunities exist within a given ditch and do not require an external market mechanism.

Modeling of ditch company decisions regarding water leases (in and out) has been initiated in the form of a generic linear programming model incorporating pre-plant climate forecasts and the probabilities of different climate states through the growing season. Progress has been slowed by data problems on water applications. The next step will be to characterize towns' (as the other major participant) decisions to lease water (in and out) incorporating the desired level of reliability of urban supplies.

Complementary to these modeling efforts has been attendance at many meeting of the State Water Supply Initiative, a major state-wide study of regional water demands and potential supplies. Co-PI Wiener has made significant contributions to these deliberations from the earlier findings of this project. This provides a second direct link with the State's water decision-making

process. The Project continues to educate the broader regional community on the functioning and potential benefits of the water bank through the Project's Advisory Committee and through attendance at regional public meetings

B. Objective of Research Project (Text Limit: one paragraph)

The major objective of the Project is to strengthen public education concerning the new institutions that have been created in response to the drought. This educational process emphasizes the importance of climate information in the management of irrigated agriculture and the determination of urban water demands. Barriers to the effectiveness of the newly created Water Bank continue to be investigated, while modeling of alternative designs of the Water Bank and the behavior of its rural and urban participants is intended to lead to recommendations for appropriate operations and acceptance of the Bank.

C. Approach (including methodological framework, models used, theory tested) (Text Limit: one page)

The basic methods involve extensive interviewing, participation in public water-planning meetings in the Arkansas Valley and elsewhere where similar problems exist, and formal modeling of irrigation and urban water offer curves to characterize likely participation in the Water Bank. The modeling involves spread-sheet templates and programming models created to generate offer curves describing the prices at which farms, ditches and municipalities would seek to acquire or transfer water. Modeling of the water bank itself will be used to compare the efficiency of different modes of bank operation, particularly the ordinary "bulletin board" and "sealed bid double auction" modes.

D. Description of any matching funds used for this project. (Text Limit: one paragraph)

While no additional cash has been acquired, the Project has received many contributions in professional expertise and staff time from USDA, NRCS, Colorado State University and Colorado Cooperative Extension Services and work and travel time greatly in excess of funded time from Howe and Wiener.

II. Interactions.

A. Description of interactions with decision-makers who were either impacted or consulted as part of the study; include a list of the decision makers and the nature of the interaction; be explicit about collaborating local institutions. (Text Limit: half page)

Decision-makers consulted: (1) Officials of Southeastern Colorado Water Conservancy District, on water bank procedures, knowledge of public perceptions, questions and comments received, information on particular listings and subsequent activities concerning listings; general discussion of reasons for lack of transactions, prevailing water politics issues (Bob Hamilton, Water Resources Manager; Phil Reynolds, CFO/Operations Manager; less, James Broderick, General Manager); (2) USDA Natural Resources Conservation Service: District Conservationist John Knapp, Dr. Lorenz Sutherland, on water bank design, public perceptions, issues of concern to Valley agriculture, and crop water use co-efficients and water use modeling for model construction; (3) Colorado State Cooperative Extension Service: Dr. Reagan Waskom on model methodology, and Dr. Jeffrey Tranel on agricultural enterprise budgets; (4) contacts with a variety of others whose opinions we seek on issues of public perception and concern: County Commissioners (Matt Heimerich of Crowley, Kevin Karney and Jake Klein of Prowers County); Bent County Commissioner & President of the Lower Arkansas Valley Water Conservancy District, Leroy Mauch; (5) A variety contacts through participation in the Arkansas Basin and South Platte Basin technical roundtable meetings and commenting for the Statewide Water

Supply Initiative, with roundtable members representing almost all water user groups or interests, the technical staff for the contractor CDM, Inc. (which has incorporated some of our materials and slide points), and the Colorado Water Conservation Board staff on the project. The Project has benefited from exhibition of posters at the Natural Resources Law Center water law conference (June, 2004), the Central Plains Irrigation Association annual conference, the South Platte Forum, the Arkansas River Basin Water Forum, and the Ogallala Symposium.

B. Description of interactions with climate forecasting community (i.e., coordination with NOAA climate forecasting divisions, the International Research Institute for climate prediction (IRI), regional or local climate forecasting entities, etc.) (Text Limit: half page)

Project participants have had extensive interaction with Boulder NOAA groups e.g. the Climate Diagnostics Center and the Western Water Assessment (Colorado RISA project). The most recent interactions have been with the larger forecasting and applications community through participation in the Climate Prediction Applications Science Workshop in Tallahassee, FL, March 2004, in organization, moderation, and reporting of a panel discussion on "Learning From and About Cooperative Extension", and presentation on agricultural weather and climate information needs and desires to the National Weather Service Central Region Sub-Regional (Boulder) meeting August 24-25, organized by Dr. Doug Kluck. Prior to that, we presented a poster and a paper at the American Meteorological Society Annual Meeting in Seattle, January 2004, on potential applications of climate information in small agriculture water management.

C. Coordination with other projects of the NOAA Climate and Societal Interactions Division (i.e., other HDGCR, Research Applications, or Regional Integrated Sciences and Assessments projects) (Text Limit: half page)

Earlier meetings included OGP-funded water investigators here in 2000 and two OGP Human Dimensions meetings (Tucson, Seabrook Island), as well as two Climate Prediction Applications workshops. We maintain informal contact with the Western Water Assessment (RISA) here in Colorado. The present foci are leading to more contact with agricultural and water managers, including participation in the Statewide Water Supply Investigation.

III. Accomplishments

A. Brief discussion of research tasks accomplished. Include a discussion of data collected, models developed or augmented, fieldwork undertaken.

Please see earlier sections of this report. Large amounts of data on water management and agricultural decisions have been collected over the four year effort of “Three States” and the Water Bank phases. Models of ditch company management, urban water demand and water bank operations are under construction. The major accomplishments have been the extensive inputs into the design of the new Arkansas Valley institutions (Water Bank & Lower Ark Conservancy District) and educational efforts relating to the Water Bank. Fieldwork has included the interactions with water and agricultural decision-makers noted above.

B. Summary of any preliminary findings (i.e., how this research advances our scientific understanding) (Text Limit: 2 pages)

Findings on the perceptions of the water bank and objections to it are pushing us toward issues of the design of the water bank, its scope and the compromises from ideal market operations, and social or cultural factors militating against inquiry into use of the water bank. Failure to cross thresholds of acceptance reduced interest in the particulars or the illustrative demonstrations.

A primary finding (subject to possible revision during 2005) is that the water bank has not been successful, in spite of the strong theoretical justifications that led to the trial: greater water

flexibility; power of a market to transmit information; reduction of risk to individual farmers, etc. The potential participants were not sufficiently aware of these advantages and they proved very risk averse. Population characteristics of the region are important in that older farmers are less likely to participate in spite of the possible financial gains. The use of computer websites for participating in the Bank appears to arouse tensions & concerns -- issues likely not to apply to future applications. It is clear that Agricultural Extension must have a major role in the introduction of innovations like the Bank.

C. List of any papers and presentations arising from this project thus far; please send reprints of journal articles as they appear in the literature.

The most recent statement is in the Proceedings of the U.S. Committee on Irrigation and Drainage, Water Rights and Related Water Supply Issues, 2004 Conference (text appended; slides appended), "Water Banking in Colorado: An Experiment in Trouble?" Many professional presentations have been made as cited above. A major report, probably a monograph, is under construction summarizing the theory and practice of water banking, based heavily on the Arkansas experience. Several newspaper articles have been authored by the PI's in the Pueblo Chieftain and in regional agricultural newsletters.

D. Discussion of any significant deviations from proposed work plan (e.g., delayed fieldwork due to late arrival of funds). (Text Limit: one paragraph)

Project participants have assisted the Western Water Assessment RISA project, in several ways including facilitating collaboration with faculty at Colorado State University. This was initially time consuming. Secondly, project findings came out just as the important State Water Supply Initiative go under way and it was critical that we participate in that process. This has involved large amounts of PI Wiener's time but represents the kind of practical application desired by NOAA. Our persistent involvement has been well received with credit to the university and to NOAA. To continue supporting the Water Bank and the State Initiative, we've reserved travel funding to maintain "field work". Finally, the request for a no-cost extension was submitted in late June, 2004 and some field work had to be delayed until NOAA approval was received in late October

IV. Relevance to the field of human-environment interactions
A. Describe how the results of your project are furthering the field of understanding and analyzing the use of climate information in decision-making. (Text Limit: one page)

The Water Bank experiment is turning out to be a case study of how not to promote innovative climate information applications: the legislature did not appropriate funds for an appropriate educational program. Funds for experimental water banks in other major basins, while authorized by legislation, were not provided so far, thus precluding comparative studies as to the economic environment and its influence on participation in the new activity..

B. Where appropriate, describe how this research builds on any previously funded HDGEC research (i.e., through NSF, EPA, NASA, DOE, NGOs, etc.) (Text Limit: half page)

This research is the successor to previously-funded HDGEC research on improvement of water management through increased use of climate information (the "Three States Project"). It relates closely to the work of Pulwarty and Redmond on the use of seasonal forecasts in Columbia River management

C. How is your project explicitly contributing to the following areas of study? (Text Limit: one paragraph per relevant area)

1. Adaptation to long-term climate change:

Changed water management will be critical for adaptation in the West. This work will have value as a case of attempted institutional innovation in the western U.S..

2. Natural hazards mitigation:

Drought response is inherent in the motivation and application for this work. Successful establishment of increased flexibility will be valuable for drought management for both cities and agriculture, where investment can be better supported if water supply can be assured for high-cost improvements. Improved climate responsiveness increased flexibility are essential for increased resilience.

3. Institutional dimensions of global change:

Western water management will continue to operate within a property rights and market legal framework, and this case is an important attempted application of economic principles to modification of the legal framework. It also, however, collided with the traditions of agricultural innovation and the sub-cultural needs and preferences of the people affected.

4. Economic value of climate forecasts:

In the small agriculture sector, any value from climate forecasts will depend on ability to change behavior or choices in response, so establishment of potential practice and institutions is needed to obtain value.

5. Developing tools for decision makers and end-users:

The simple models will assist decision-makers considering their potential use of the new institutions and opportunities. Indirectly, this work will provide information that may be used to redesign the water bank pilot program to be more useful.

6. Sustainability of vulnerable areas and/or people:

Rural Plains areas and the small agriculture sector of the Intermountain West are vulnerable and already severely stressed.

7. Matching new scientific information with local/indigenous knowledge:

Water managers and farmers have a vast stock of experience and intuition regarding climate and agricultural response. In some settings, this represents a strong complement to available climate records and forecasts, while in others it can create a barrier to acceptance of information on changing climate regimes. Younger water managers and agricultural managers are much more aware of advances in the relevant sciences and sources of information.

8. The role of public policy in the use of climate information:

Some state and federal agencies may see improved (changed) climate information availability as a threat to established ways of interpreting and disseminating climate and hydrologic information. The "Three States" project and this successor have interacted with policy makers less than with agency people, but legislators and others are interested in improved forecast applications as well as better forecasts, and aware of the distinction.

9. Socioeconomic impacts of decadal climate variability

Not applicable to most water storage and distribution system management. However, long term, multiple decade drought threats are now being taken seriously for the first time, especially in the Colorado River Basin.

V. Graphics -- Please include the following graphics as attachments to your report:
Included in Powerpoint ™ slides appended.
Photographs from fieldwork to depict study environment.
Previously provided in reports, and in Powerpoint ™ slides appended.

VI. Website address for further information (if applicable).